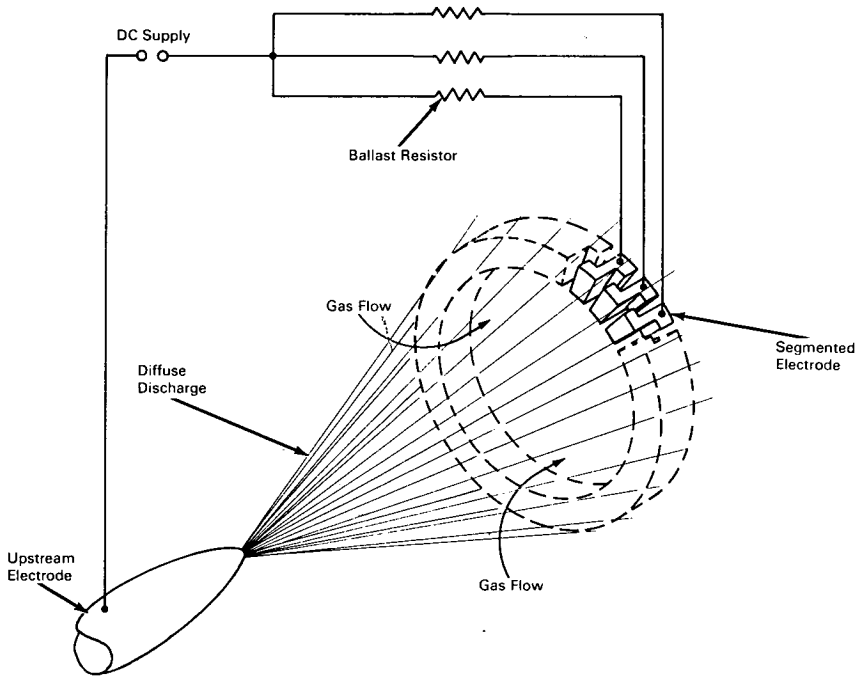
Brief 65-10356

NASA TECH BRIEF

Segmented Electrode Increases Operating Pressure of MHD Accelerator



The problem: A recently developed self-induced MHD (magnetohydrodynamic) accelerator for spacecraft propulsion is capable of accelerating the gas being exhausted to extremely high speeds (700,000 ft/sec for hydrogen and 320,000 ft/sec for nitrogen). This accelerator produces a hollow, cone-shaped, diffuse discharge between two electrodes, one of which is a solid ring. The diffuse (circumferentially continuous) discharge, which is a necessary condition for effective functioning of the MHD accelerator, occurs only at low ambient pressures (less than approximately 0.1 atmosphere) when the solid-ring electrode is used. To meet requirements for application in high-speed wind tunnels, an MHD accelerator must operate at pressures of 1 to 10 atmospheres. It was therefore necessary to modify the design of the solid-ring electrode to create a diffuse discharge at these considerably higher pressures.

The solution: Use a circumferentially segmented-ring electrode in place of the solid-ring electrode in the basic MHD accelerator.

How it's done: The electrode ring is composed of uniformly spaced segments, each of which has a width approximately equal to the diameter of a single arc-conduction column. A ballast resistor is connected between each segment and one terminal of the common electrical power supply. The solid ogival

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electrode, centrally positioned upstream from the segmented electrode, is connected to the opposite terminal of the power supply.

To initiate the discharge, an arc is struck between the upstream electrode and one of the segments of the ring electrode, producing a current and consequent voltage drop in the ballast resistor connected to the segment. The potential of this conducting segment relative to the upstream electrode will therefore be less than that of the other segments, and the arc will spread to the immediately adjacent segments on each side of the conducting segment. This spreading continues from segment to segment until the discharge from the downstream electrode diffuses over the entire segmented arc.

Notes:

1. Experimental data from arc heaters indicate that the segmented-ring electrode in an MHD accelerator will produce diffuse discharges at pressures as high as 100 atmospheres.
2. This invention will have application in hypervelocity wind tunnels and arc heaters.
3. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Langley Research Center
   Langley Station
   Hampton, Virginia, 23365
   Reference: B65-10356

Patent status: NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

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Langley Research Center
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